MODULE

FIVE

This module addresses writing linear equations.

SC Academic Elementary Algebra Standards included in this module are:

EA-4.1 Carry out a procedure to write an equation of a line with a given slope and a *y*-intercept.
EA-4.2 Carry out a procedure to write an equation of a line with a given slope passing through a given point.
EA-4.3 Carry out a procedure to write an equation of a line passing through two given points.
EA-4.4 Use a procedure to write an equation of a trend line from a given scatterplot.
EA-4.5 Analyze a scatterplot to make predictions.
EA-4.6 Represent linear equations in multiple forms (including point-slope, slope-intercept, and standard).
EA-5.9 Analyze given information to write a linear function that models a given problem situation.
EA-5.10 Analyze given information to determine the domain and range of a linear function in a problem situation.

Lesson # 1
Topic: Writing a linear equation using slope and y-intercept
Standard (s): EA – 4.1

I. Planning the Lesson

The first bullet under the Continuum of Knowledge represents student's prior knowledge and/or skills needed to meet this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**
  - In 7th grade, students analyze tables and graphs to determine the rate of change among and between quantities (7-3.2). They also develop an understanding of slope as a rate of change (7-3.3). In 8th grade, students identify the slope (8-3.7) and the y-intercept (8-3.6) from a graph, equation and/or table. Also in 8th grade, students represent algebraic relationships with equations and inequalities (8-3.2).
  - In elementary Algebra, students carry out a procedure to write an equation of a line with a given slope and a y-intercept.
  - In Intermediate Algebra, students carry out a procedure to write an equation of a quadratic function when given its roots (IA-3.6).

- **Taxonomy**
  3.1-C
  Cognitive Process Dimension: Apply
  Knowledge Dimension: Procedural Knowledge

- **Key Concepts**
  Slope
  y-intercept
  Slope-intercept form

II. Teaching the Lesson

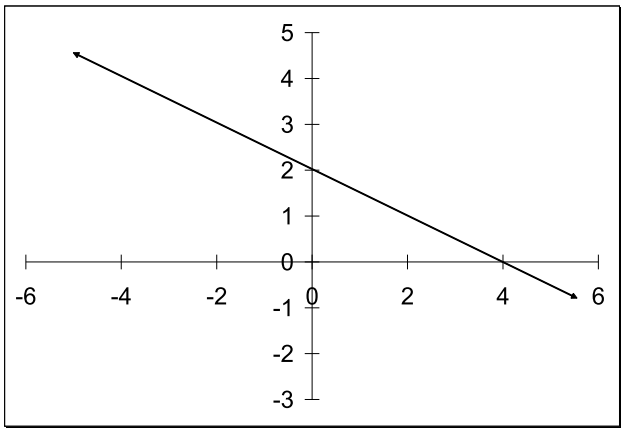
In this lesson, students write linear equation given a slope and y-intercept. Students extract the value of the slope and y-intercept from a graph, a table of values or a verbal description thereby building on their prior knowledge from Module 3. In addition to becoming fluent in this procedure, students interpret the meaning of the slope and y-intercept in real world situations. Students also translate their final answer to multiple forms. To review the procedure of translating linear equations, see Lesson #2 from Module 3.

- **Essential Learning and Understanding**
  It is essential for students to do the following for the attainment of this indicator:

  - Find the slope of a linear function from a graph or table of values.
  - Recognize and use the slope intercept form of a linear equation
  - Work with integral and fractional values for the slope and y-intercept

- **Examples of Essential Tasks**
  These examples of essential tasks are not all inclusive. They are provided to give additional clarification of possible tasks that students should be able to successfully complete.

  - Write the equation for the linear function with a slope of $\frac{1}{2}$ and a y-intercept of $\frac{-1}{4}$.
  - Write the equation of the line whose slope is -4 and passes through the (0,-2)
  - Write the equation for the linear function with a slope of -5 and whose graph crosses the y-axis at 3.
  - Write the equation of the line for the graph given below.



- **Non-Essential Learning and Understand**
  It is not essential for students to do the following for the attainment of this indicator but could be important for the attainment of other indicators within Elementary Algebra:

None noted

- **Examples of Non-Essential Tasks**
  The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.

  None noted

- **Misconceptions/Common Errors**
  - Students may not recognize that the value of b in the slope-intercept form must be the y-intercept
  - Students confuse the x-intercept $(x,0)$ with the y-intercept $(0,y)$
  - When slope-intercept form is given as $y = b + mx$ students confuse the slope and y-intercept
  - Students may not recognize $y = b + mx$ as an equivalent form of $y = mx + b$. Also students are confused when variables other than m and b are used to represent the slope and y-intercept.

- **Technology**
  Students may use a graphing utility to graph their resulting equation. They can use the graph to verify that the line has the given slope and crosses at the given y-intercept. This gives students additional practice in determining the slope and y-intercept from a graph.

III. Assessing the Lesson

Assessment Guidelines: *This objective of this indicator is for the student to carry out a procedure to write a linear equation given a slope and y-intercept. Therefore, the primary focus should be on students using slope-intercept form to write such equations. As indicated by the Bloom's verb carry out, students apply a procedure to a familiar task. Students may need to use appropriate procedures to determine the slope and y-intercept from the given information in order to write the equation of the line.*

- **Assessment Item Examples**

  - What is the equation of the line with a slope of 2/3 and a y-intercept of 3?

    A. $x = \frac{2}{3}y + 3$

    B. $x = \frac{2}{3}y - 3$

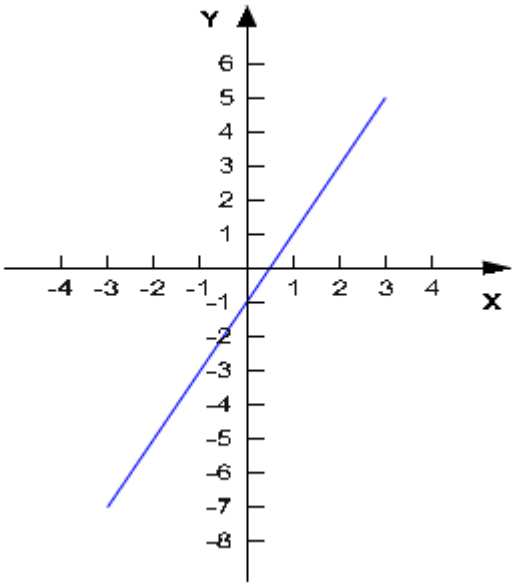
C. $y = \frac{2}{3}x + 3$

D. $y = \frac{2}{3}x - 3$

- What is the equation of the line with a slope of -3 and a y-intercept of 1?
  A. x = -3y + 1
  B. y = -3x +1
  C. y = -3x – 1
  D. x = -3y – 1

- Which equation of the line below has a slope of -1 and passes through the point (3, 2)?
  A. y = -x + 5
  B. y = -x + 2
  C. y = -x + 3
  D. y = -x - 2

- What is the equation of the line for the graph below?



A. y = 2x – 1
B. y = x – 1
C. y = 2x
D. y = x - 2

IV. Resources

Pencil Me In: *In this activity, examine linear functions using the multiple representations. Given a table of values, students create a graph and a linear equation in order to solve a real world problem.*
Lighting Up the Sky: *This activity has two parts. Part I focuses on linear functions. Part II is used in the Module 8 on Quadratic Functions.*

PENCIL ME IN!!

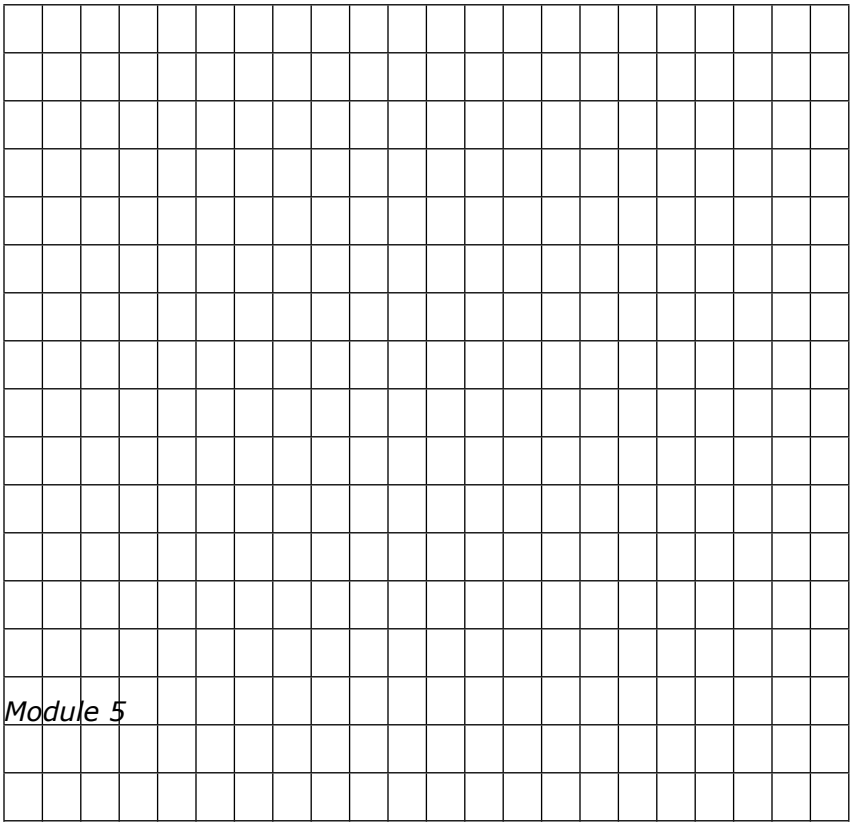
The manager of the Westview High School student store plans to place an order for pencils that are imprinted with the school logo. The company charges a flat fee for shipping and handling regardless of the number of packages ordered.
The order form got wet and only a small portion of it is legible. That portion is displayed in the table below.

Number of packages ordered	1	2	3
Total Cost of Order (including shipping and handling)	$15	$25	$35

Based on the information in the table, the school manager calculates that the total cost of ordering 20 packages is $210.

Answer the questions below to determine if his calculations are correct.

1. **Plot the data** in the table on the graph below. Label (name) the axes and choose scales for each indicating the units you selected.



Y

0

X

2. Identify the **independent** and **dependent** variables.

Independent

_____ Dependent _____

3. **Functional Relationship**. Using the independent and dependent variables, fill in the blanks to show their functional relationship.

The _____ is a linear function of the _____.

4. **Explore this linear relationship.** 

a. Write a linear equation that models the data. Show the work that led to your answer.

b. What is the rate of change for the data?

c. What does the rate of change represent in the context of this problem?

d. What is the y-intercept of the line that contains the data points?

e. What does the y-intercept mean in the context of this problem?

Is his calculation that 20 packages cost $210 correct? Explain your reasoning using the table, graph and/or equation to justify your answer.

LIGHTING UP THE SKY

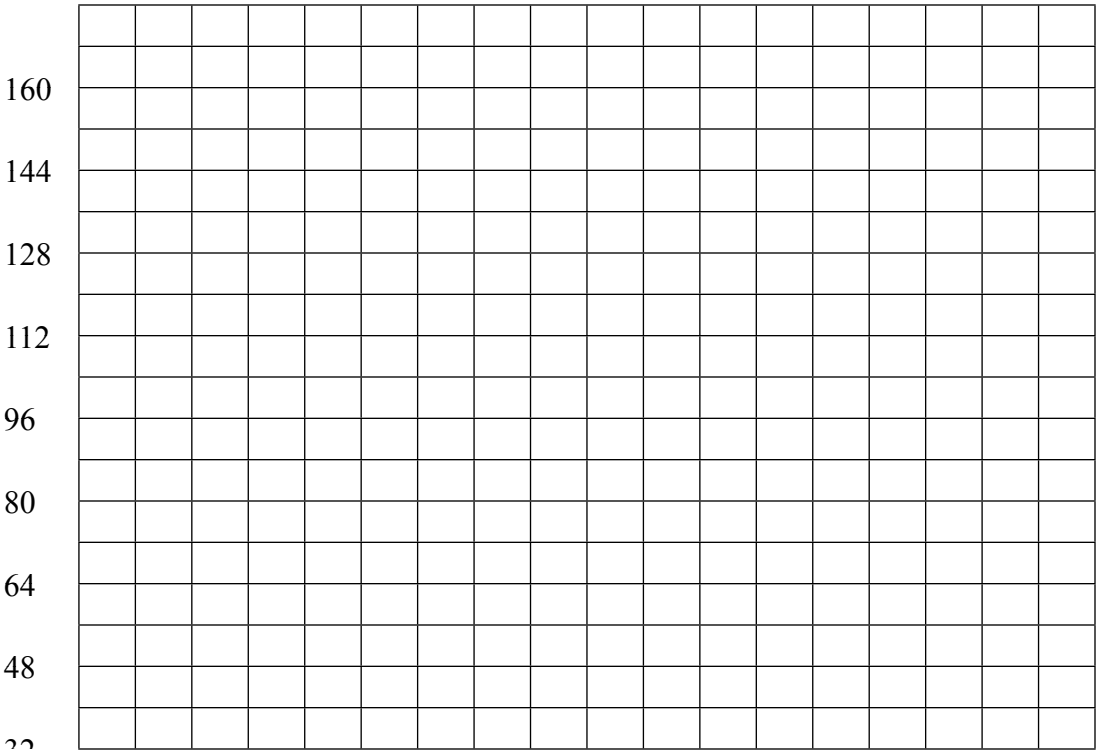
Part I

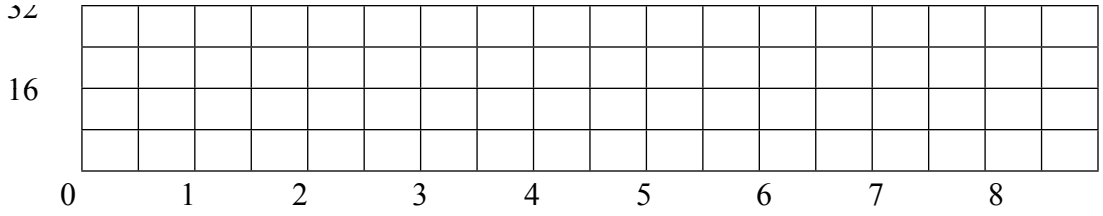
On Friday night, Mr. Burton's science class is releasing a weather balloon as part of a class science project. The weather balloon will be launched from the roof of the school. The distance from the roof to the ground is 32 feet. The balloon rises at a rate of 8 feet per second.

1. Based on the information above, complete the table of values.

Height of the balloon from the ground after 0 seconds	32 feet
Height of the balloon from the ground after 1 second	_____ feet
Height of the balloon from the ground after 2 seconds	_____ feet
Height of the balloon from the ground after 3 seconds	_____ feet
Height of the balloon from the ground after 3.5 seconds	_____ feet

2. Label (name) the axes on the grid below. Draw a graph of the height (feet) of the balloon from the ground versus time (seconds) from 0 seconds to 8 seconds.





3. Does the data represent a **linear relationship**? Explain using the table or graph to justify your answer.

4. Let *t* represent the time (seconds). Write an **equation** for the height (feet), *h*, of the balloon above the ground in terms of *t*.

5. The equation from #4 is a variation of the **slope intercept** form of a linear equation. Create a correspondence between the variables in your equation and the variables in the slope intercept form y = mx + b.

		Your equation
y	corresponds to	_____
m	corresponds to	_____
x	corresponds to	_____
b	corresponds to	_____

6. What does the **slope** mean in the context of this problem?

7. What does the **y-intercept** mean in the context of this problem?

Lesson # 2
Topic: Write a linear equation given a slope and a point
Standard (s): EA – 4.2

I. Planning the Lesson

The first bullet under the Continuum of Knowledge represents student's prior knowledge and/or skills needed to meet this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**
  - In 6th grade, students represent the location of a point with an ordered pair (6-4.1). In 7th grade, students examine slope as a rate of change (7-3.3). In 8th grade, students identify the slope (8-3.7), use ordered pairs to locate a point in the coordinate plane (8-4.2) and represent algebraic relationships with equations and inequalities (8-3.2).
  - In Elementary Algebra, students carry out a procedure to write an equation of a line with a given slope passing through a given point.
  - This essential skill is necessary in all subsequent study of mathematics.

- **Taxonomy**
  3.1-C
  Cognitive Process Dimension: Apply
  Knowledge Dimension: Procedural Knowledge

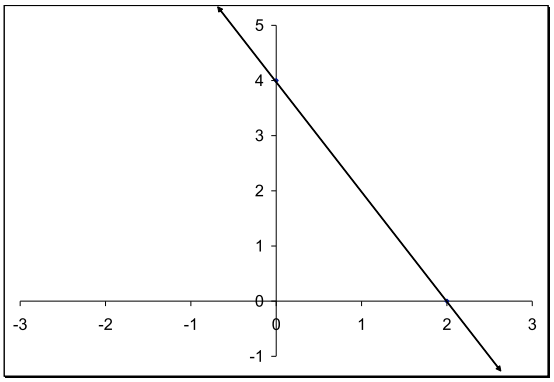
- **Key Concepts**
  Slope
  Slope-intercept form
  Point-slope form

II. Teaching the Lesson

In this lesson, students write the equation of a line given the slope and a point. Students extract the value of the slope and the coordinates of a point from a graph, a table or a verbal description. In addition to becoming fluent in this procedure, students translate their final equation to other linear forms such as slope intercept and standard form. To review the procedure of translating linear equations, see Lesson #2 from Module 3.

- **Essential Learning and Understanding**
  It is essential for students to do the following for the attainment of this indicator:
  - Find the slope of a linear function from a graph or table of values.
  - Recognize and use the slope-intercept form or point-slope form of a linear equation in order to write the equation.
  - Work with integral and fractional values for the slope and the coordinates of the given point

- **Examples of Essential Tasks**
  These examples of essential tasks are not all inclusive. They are provided to give additional clarification of possible tasks that students should be able to successfully complete.
  - Write the equation of a line passing through the point (-1,6) with a slope of -4
  - Write the equation of a line whose slope is $\frac{-3}{4}$ and passes through the point $(-2,5)$
  - Write the linear equation for the graph below.



- Write the equation of the line that is parallel to the line $y = -4x + 3$ and passing through the point (1, 2)

- Write the equation of the line that is perpendicular to the line 2x – 3y = 6 and passes through the point (4,-1)

- **Non-Essential Learning and Understand**
  The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.
  None noted

- **Examples of Non-Essential Tasks**
  The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.
  None noted

- **Misconceptions/Common Errors**
  - Students using the slope-intercept form may substitute the y value of the given point in for the value of *b* although the given point may not represent the y-intercept.
  - Students using the point-slope form may not recognize that $x_1, y_1 \text{ and } m$ represent constants and x and y represent variables.

- **Technology**
  Students may use a graphing utility to graph their resulting equation. They can use the graph to verify that the line has the given slope. While on the graph screen, students can verify that the line crosses at the given point by using the value function under the CALC menu.

III. Assessing the Lesson

Assessment Guidelines: *This objective of this indicator is for the student to <u>carry out</u> a procedure for writing the equation of line with a given slope and a given point. Therefore, the primary focus should be on students using such procedure to write the equations.*

- **Assessment Item Examples**

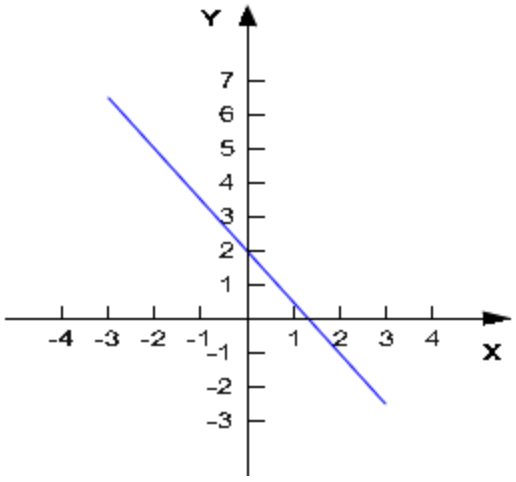
  - What is the equation of the line with a slope of 2 and whose graph crosses the y-axis at -5?
    A. 2x + y = 5
    B. 2x – y = 5
    C. 2x + y = 7
    D. 2x – y = -7

- What is the equation of the line with a slope of -2/3 which contains the point (4, 5)?
  A. 2x + 3y = 11
  B. 2x + 3y = 7
  C. 2x + 3y = 22
  D. 2x + 3y = 23

- What is the equation of the line that is parallel to y = 3x – 2 and passes through the point (2, -1)?
  A. $y = \frac{1}{3}x - \frac{5}{3}$
  B. $y = \frac{1}{3}x + 3$
  C. y = 3x – 7
  D. y = 3x + 5

- What is the equation of the line that is perpendicular to 2x + 3y = 4 and passes through the point (6, -2)?
  A. $y = \frac{3}{2}x + 9$
  B. $y = \frac{3}{2}x - 11$
  C. $y = -\frac{2}{3}x + 2$
  D. $y = -\frac{2}{3}x + 10$

- Find the equation of the line shown in the graph below.



A. 2x + 3y = 4
B. 2x – 3y = 4
C. 3x – 2y = 4
D. 3x +2y = 4

IV. Resources

Lesson # 3
Topic: Writing a linear equation given two points
Standard (s): EA – 4.3

I. Planning the Lesson

The first bullet under the Continuum of Knowledge represents student's prior knowledge and/or skills needed to meet this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**
  - In 8th grade, students identify the slope of a linear equation from a graph, equation, and/or table (8-3.7).
  - In Elementary Algebra, students carry out a procedure to write an equation of a line passing through two points.
  - This essential skill is necessary in all subsequent study of mathematics.

- **Taxonomy**
  3.1-C
  Cognitive Process Dimension: Apply
  Knowledge Dimension: Procedural Knowledge

- **Key Concepts**
  Slope
  y-intercept
  Slope-intercept form
  Point-slope form

II. Teaching the Lesson

In this lesson, students write the equation of a line given the slope and a point. Students extract the value of the slope and the coordinates of two points from a graph, a table or a verbal description. In addition to becoming fluent in this procedure, students translate their final equation to other linear forms such as slope intercept and standard form. To review the procedure of translating linear equations, see Lesson #2 from Module 3.

- **Essential Learning and Understanding**
  It is essential for students to do the following for the attainment of this indicator:

  ○Find the slope of a linear function from a graph or table of values.
  ○Use the slope-intercept form or point-slope form of a linear equation in order to write the equation of a line
  ○Work with integral and fractional values of the slope and coordinates

- **Examples of Essential Tasks**
  These examples of essential tasks are not all inclusive. They are provided to give additional clarification of possible tasks that students should be able to successfully complete.

  ○ Write the equation of the line passing through the points $(-2.-1)$ and (4, 0)
  ○ Write a linear equation for the line passing through the points $\left(\frac{2}{3},4\right)$ and $\left(\frac{-1}{3},-2\right)$

Write a linear equation to represent the data in the table of values below.

X	Y
-1	2
0	-1
1	-4
2	-7
5	-10

- **Non-Essential Learning and Understand**
  It is not essential for students to do the following for the attainment of this indicator but could be important for the attainment of other indicators within Elementary Algebra:

  Write linear equations for two points containing all fractional coordinates.

- **Examples of Non-Essential Tasks**
  The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.

  Write the equation of the line passing through the points $\left(\frac{-3}{4},\frac{2}{3}\right)$ and $\left(\frac{-1}{2},\frac{4}{5}\right)$.

- **Misconceptions/Common Errors**
  - Students determine the slope using the formula $m=\frac{x_2-x_1}{y_2-y_1}$
  - Students determine the slope using the formula $m=\frac{y_2-y_1}{x_1-x_2}$
  - Students using the slope-intercept form may substitute the y value of the given point in for the value of *b* although the given point may not represent the y-intercept.
  - Students using the point-slope form may not recognize that $x_1, y_1 \text{ and } m$ represent constants and x and y represent variables.

- **Technology**
  Students may use a graphing utility to graph their resulting equation. They can use the graph to verify that the line has the given slope. While on the graph screen, students can verify that the line crosses at the given points by using the value function under the CALC menu.

III. Assessing the Lesson

Assessment Guidelines: *This objective of this indicator is for the student to carry out a procedure to write the equation of line passing through two points. Therefore, the primary focus of the assessment should be for students to carry out such procedures.*

- **Assessment Item Examples**
  - What is the equation of the line that passes through the points (3, -2) and (0, 4)?
    A. 2x + 3y = 12
    B. x + 2y = -12
    C. 4x – 2y = 7
    D. 2x + y = 4

- What is the equation of the line passing through the points (8, 4) and (5, -1)?
  A. $5x - 3y = 8$
  B. $5x - 3y = -7$
  C. $x - y = -6$
  D. $3x - 5y = 12$

- Write an equation to represent the data in the table of values below.

X	Y
-4	1
-2	0
0	-1
2	-2
4	-3

A. $x + 2y = -2$
B. $-x + 2y = -2$
C. $2x + y = 2$
D. $x - 2y = 2$

IV. Resources

Lesson # 4
Topic: Analyzing scatterplots to make predications
Standard (s): EA – 4.5

I. Planning the Lesson

The first bullet under the Continuum of Knowledge represents student's prior knowledge and/or skills needed to meet this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**
  - In 8th grade, students generalize the relationship between two sets of data by using scatterplots and lines of best fit (8-6.1) and organize data in matrices or scatterplots as appropriate (8-6.2).
  - In elementary algebra, students analyze a scatterplot to make predictions
  - In Data and Probability, students organize and interpret data by using scatterplots (DA-3.2, DA-3.3) then classify the scatterplot by shape (DA-3.5). Students also determine a trend line using visual approximation and technology (DA-3.7, DA-3.8).

- **Taxonomy**
  4.1-C
  Cognitive Process Dimension: Analyze
  Knowledge Dimension: Conceptual Knowledge

- **Key Concepts**
  Prediction
  Scatterplot

Correlation
Independent variable
Dependent variable

II. Teaching the Lesson

In this lesson, students analyze scatterplots to make predictions. Although, students have generalized relationship between sets of data and graphed scatterplots in the 8th grade, they may need to examine the concept in a real world application. Using estimation to analyze scatterplots in order to make predictions builds a foundation for the next lesson which is writing a trend line for a given scatterplot. Understanding that without a trend line, the ability to make predictions are limited by scope and accuracy, gives a purpose to the process of finding the trend line.

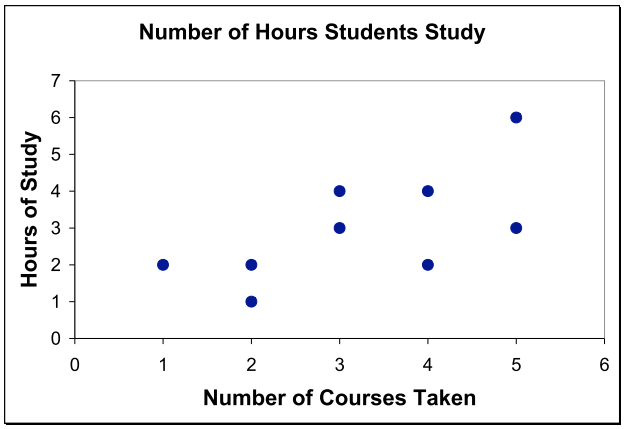
- **Essential Learning and Understanding**

  - Positive, negative and no correlation
  - Determine the meaning of the slope, y-intercept and coordinates in a contextual problem.
  - Use the concept of slope as a rate of change to make predictions
  - Determine which axis represents the independent and dependent variables

- **Examples of Essential Tasks**

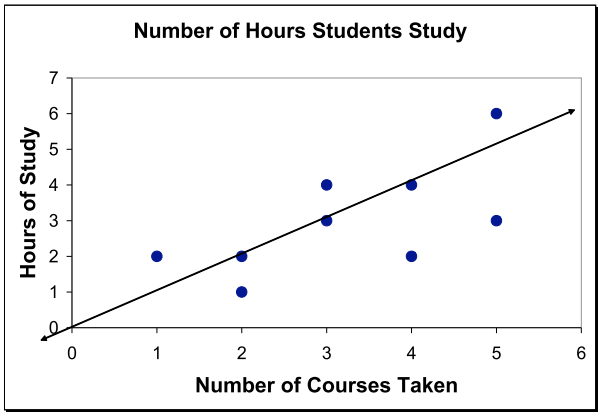
  These examples of essential tasks are not all inclusive. They are provided to give additional clarification of possible tasks that students should be able to successfully complete.

  - If this graph represents hours studied per week, what is a reasonable prediction for the number of hours studied for six courses taken?



Suitable answers are between 5 and 6. Teacher may determine a suitable range for answers.

- If the graph below represents the hours a student studies per week, what is a reasonable prediction for the number of hours a student studies for seven courses?



Note: We have to be careful when extrapolating. Hours in a week is a limited resource with an upper limit, so we can expect to lose linearity at some point.

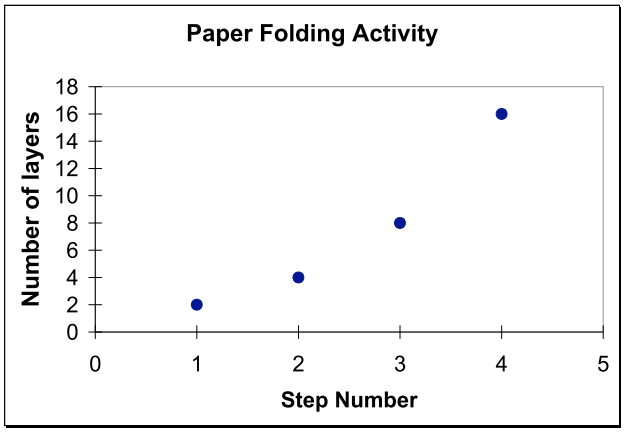
- **Non-Essential Learning and Understand**
  It is not essential for students to do the following for the attainment of this indicator but could be important for the attainment of other indicators within Elementary Algebra:

  - Analyze a scatterplot that resembles non-linear data
  - Make predictions using data that has no correlation
  - Write the equation for the trend line in order to make their predictions. Students may only need to draw a trend line then make their predictions

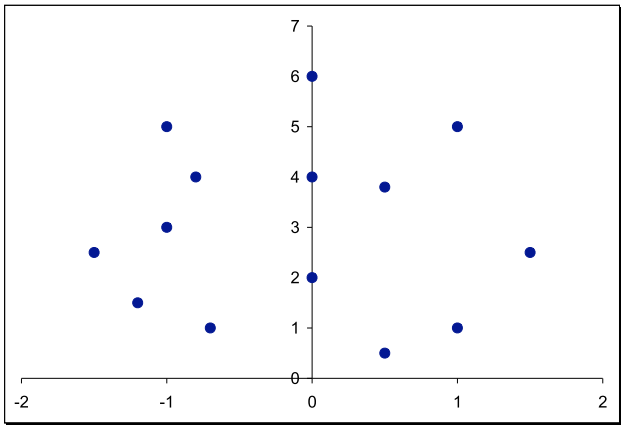
- **Examples of Non-Essential Tasks**

  The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.

  - What is a reasonable prediction for the number of layers when you are on step 7 of this paper folding activity?



  - What type of correlation is represented by the data? How effective would this data be in making a prediction? Explain your answer.



- **Misconceptions/Common Errors**
  - Students may assume that the scales of the axes are always in increments of one. This has an effect on the prediction values.
  - Students should be very careful when extrapolating. Unless there is a very good reason to expect the relationship to continue to be linear beyond our data, we should not assume it is linear beyond given data.

- **Technology**

Many data collection activities will result in a large set of data points. Technology should be used to create these types of graphs instead of manual graphing methods which may allow for more time to analyze their meaning.

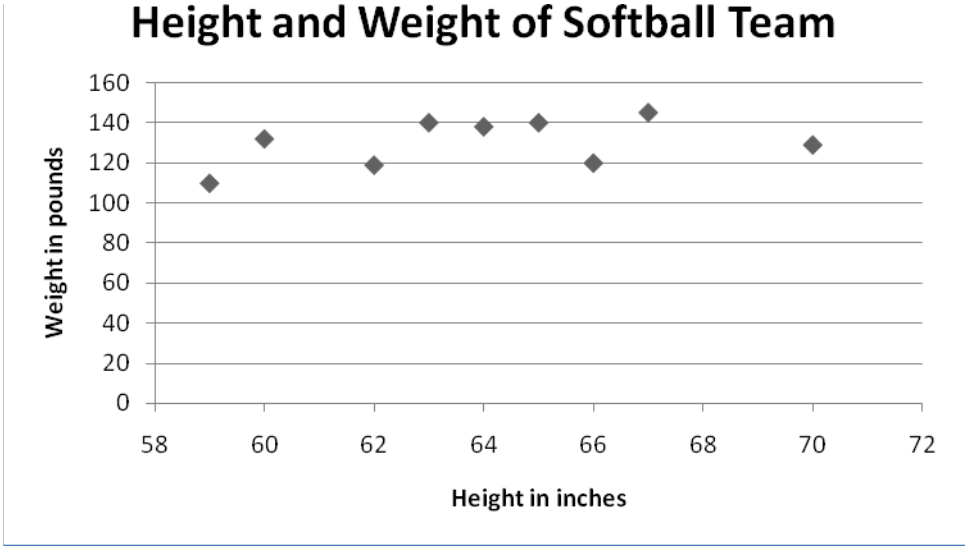
One of the difficulties students have when using a graphing utility to create a scatterplot is setting the viewing window. Students need sufficient practice performing this skill.

III. Assessing the Lesson

Assessment Guidelines: *This objective of this indicator is for the student to analyze a scatterplot to make predictions. Therefore, the primary focus of the assessment should be for students to determine the relationship of the data, if any, and determine how this relationship affects the overall structure of the scatterplot. Students should be able to make reasonable estimates based on this analysis. Although writing the equation of the trend line may be helpful, the focus of this indicator is to analyze.*

- **Assessment Item Examples**

As manager of the softball team at your school, you have recorded the height and weight of the players on the team. The scatterplot below shows the result of these measurements.



What is a reasonable prediction for the weight of a softball player who is 69 inches tall?

A. 150 pounds
B. 110 pounds
C. 130 pounds
D. 145 pounds

IV. Resources

Lesson # 5
Topic: Writing the equation of a trend line
Standard (s): EA – 4.4

I. Planning the Lesson

The first bullet under the Continuum of Knowledge represents student's prior knowledge and/or skills needed to meet this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**
  - In 8th grade, students generalize the relationship between two sets of data by using scatterplots and lines of best fit (8-6.1) and organize data in matrices or scatterplots as appropriate (8-6.2).
  - In elementary algebra, students use procedure to write an equation of a trend line from a given scatterplot
  - In Data and Probability, students organize and interpret data by using scatterplots (DA-3.2, DA-3.3) then classify the scatterplot by shape (DA-3.5). Students also determine a trend line using visual approximation and technology (DA-3.7, DA-3.8).

- **Taxonomy**
  3.2-C
  Cognitive Process Dimension: Apply
  Knowledge Dimension: Procedural Knowledge

- **Key Concepts**
  Trend Line
  Scatterplot
  Correlation
  Slope
  Slope-intercept form
  Point-slope form

II. Teaching the Lesson

In this lesson, students move from simply analyzing scatterplots for overall trends in data to writing a trend line that can be used to make more accurate predictions. Using this skill in context gives student a greater conceptual understanding of trend lines.

- **Essential Learning and Understanding**
  It is essential for students to do the following for the attainment of this indicator:

  ○Recognize the correlation of data represented by a scatterplot as being positive, negative and no correlation

  ○Find the slope of a linear function from a graph or table of values.

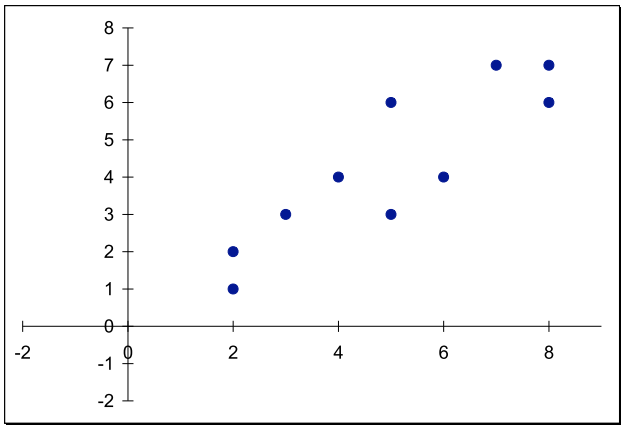
  ○Use the slope-intercept form or point-slope form of a linear equation in order to write the equation of a line

  ○Determine the reasonableness of a line of fit using visual approximation.

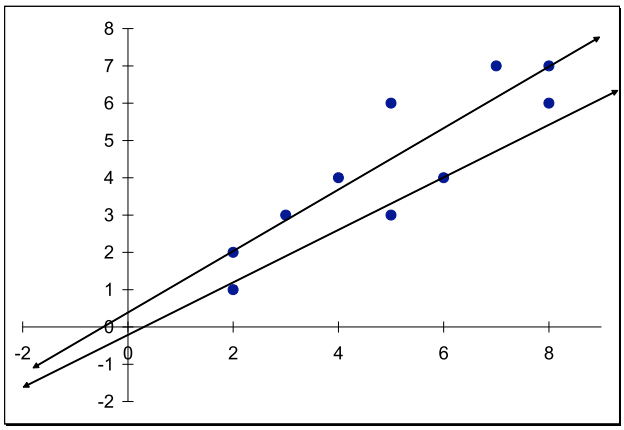
  ○Determine which axis represents the independent and dependent variables

- **Examples of Essential Tasks**
  These examples of essential tasks are not all inclusive. They are provided to give additional clarification of possible tasks that students should be able to successfully complete.

  - Write the equation of the trend line for the scatterplot shown below.



- Write the equation for the trend line that is the most reasonable line of fit for the data graphed in the scatterplot below.



- **Non-Essential Learning and Understand**
  It is not essential for students to do the following for the attainment of this indicator but could be important for the attainment of other indicators within Elementary Algebra:

  - Create scatterplots with more than 10 points using manual graphing methods.
  - Use statistical methods such as r and r^2 to determine the preciseness of the correlation

- **Examples of Non-Essential Tasks**
  The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.

  - Sketch the scatterplot then write an equation for the trend line that the most reasonable line of fit.

X	2	-1	3	4	-2	5	7	10	8	7	-6	-5	3	-9	4	6	11	12
Y	0	3	5	8	-6	8	3	-7	4	1	2	-3	5	9	10	8	-8	7

  - The correlation coefficient, r, for a given set of data is 0.9. Explain the meaning of this value in terms of the relationship between variables.

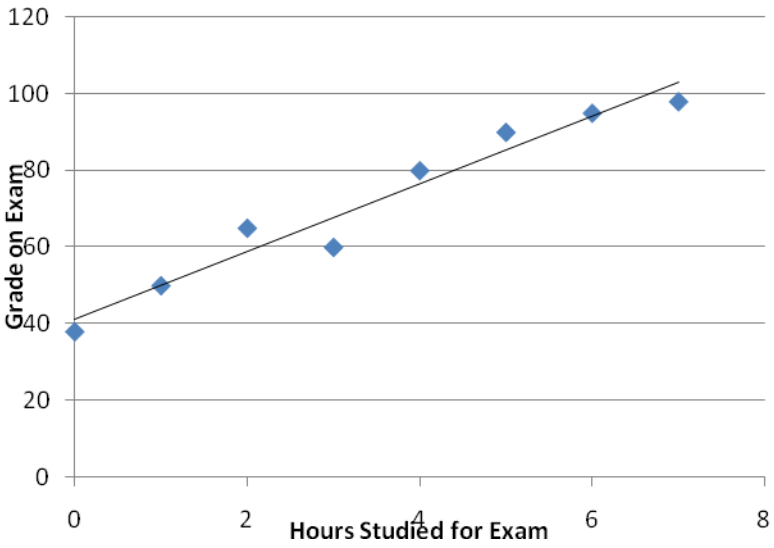
- **Misconceptions/Common Errors**
  - Students may consider a line that clearly passes through two points to be the trend line even though the line does not meet the additional criteria for a trend line.
  - Students may confuse the terms trend line (line of fit) with a line of best fit. A trend line (line of fit) is an approximation of the line of best fit. The line of best fit is determined using statistical methods involving r and r^2 to determine the precise of the correlation.

- **Technology**
  Many data collection activities will result in a large set of data points. Technology may be used to create these types of graphs instead of manual graphing methods.

III. Assessing the Lesson

Assessment Guidelines: *This objective of this indicator is for the student to <u>use</u> a procedure to write a trend line for a given scatterplot. Therefore, students should expect to use a procedure in an unfamiliar task or situation. Although the primary focus of the indicator is on the procedure of writing the trend line, students need to have an understanding of what constitutes a trend line.*

- **Assessment Item Examples**



The above scatterplot shows the number of hours that students studied for an exam and the grade received on the exam. Find the equation of the trend line that is the most reasonable line of fit for the data graphed in the scatterplot.

A. $y = 2x + 10$
B. $y = 10x + 40$
C. $y = 2x + 40$
D. $y = x + 20$

IV. Resources

Lesson # 6
Topic: Writing linear equation given a problem situation
Standards (s): EA – 5.9

I. Planning the Lesson

The first bullet under the Continuum of Knowledge represents student's prior knowledge and/or skills needed to meet this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**
  - In eighth grade, students generate and solve complex abstract problems that involve modeling physical, social, or mathematical phenomena (8-1.1).
  - In Elementary Algebra students will write a system of linear equations that models a given problem situation.

- In Intermediate Algebra, students analyze a problem situation to determine a system of linear inequalities that models the problem situation (IA-2.3)

- **Taxonomy Level**
  4.3 B
  Cognitive Process Dimension: Analyze
  Knowledge Dimension: Conceptual Knowledge

- **Key Concepts**
  Linear function
  Modeling

II. Teaching the Lesson

In this lesson, students write linear equations that model a problem situation. Although students have been writing linear equation, the focus of this lesson is extracting information from a verbal description. Students examine text for key words that indicate which values represent the rate of change (slope) and which value represents the initial amount. At the end of this lesson, students make a connection among the multiple representations (table, graph and verbal description) and how they are used to represent linear data.

- **Essential Learning and Understanding**
  It is essential for students to do the following for the attainment of this indicator:

  - Assign variables to quantities for a given problem situation.
  - Recognize relationships between variables representing quantities in a given problem situation.
  - Write a linear equation given a linear relationship between two variables.

- **Examples of Essential Tasks**
  These examples of essential tasks are not all inclusive. They are provided to give additional clarification of possible tasks that students should be able to successfully complete.

  - Todd makes $6.00 per hour working at a convenience store. He will get a bonus of $25 this week. Write a linear function the represents the amount he makes this week as a function of hours he works.
  - Carla has a lemonade stand. She spends $8.75 on materials and ingredients. She charges $0.75 for each glass of lemonade. Write a linear function that expresses her profit as a function of glasses sold.

- **Non-Essential Learning and Understanding**

It is not essential for students to do the following for the attainment of this indicator but could be important for the attainment of other indicators within Elementary Algebra:

- Evaluate the function for a particular value of x.
- Solve the function for a particular value of y

- **Examples of Non-Essential Tasks**
  The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.

  - Todd makes $6.00 per hour working at a convenience store. He will get a bonus of $25 this week. How many hours must he work to make $250?
  - Carla has a lemonade stand. She spends $8.75 on materials and ingredients. She charges $0.75 for each glass of lemonade. How many glasses does she have to sell to make her money back?

- **Misconceptions/Common Errors**
  None Noted

- **Technology Note**
  Use technology where appropriate.

III. Assessing the Lesson

Assessment Guidelines: *The objective of this indicator is to analyze given information to write linear equation to model a situation.*
Assessment should focus on writing a linear equation that models the problem situation.

- **Assessment Item Examples**

  - Rondreas makes and sells patch cables (c) for a local company. He charges $0.75 for each patch cable. He spends $8.00 for materials. Write an equation to represent his profit (p) as a function of the number of patch cables sold.
    A. P(c) = .75c – 8.00
    B. P(c) = .75c + 8.00
    C. P(c) = .8.00c - .75
    D. P(c) = .8.00c + .75

- Linda sells jewelry at craft shows. She charges $5 for each piece of jewelry. The materials for the jewelry cost $125. Write an equation to model the profit (p) as a function of the number of pieces of jewelry (j) that she sells.

  A. $P(j) = 5j + 125$
  B. $P(j) = 5j – 125$
  C. $P(j) = 125\ j + 5$
  D. $P(j) = 125j - 5$

IV. Resources

Lesson # 7
Topic: Determining domain and range of linear functions
Standard (s): EA – 5.10

I. *Planning the Lesson*

The first bullet under the Continuum of Knowledge represents student's prior knowledge and/or skills needed to meet this standard. It is recommended that students are pre-assessed on this prior knowledge.

- **Continuum of Knowledge**
  - In seventh grade, students generate and solve complex abstract problems that involve modeling physical, social, or mathematical phenomena (7.11). In eighth grade, students identify the coordinates of the *x*- and *y*-intercepts of a linear equation from a graph, equation, and/or table (8-3.6).

- In Elementary Algebra students will find the domain and range of linear functions in a problem situation.
- In Intermediate Algebra, students will carry out a procedure to determine the domain and range of discontinuous functions (including piecewise and step functions) (IA-2.10).

- **Taxonomy**
  4.3 B
  Cognitive Process Dimension: Analyze
  Knowledge Dimension: Conceptual Knowledge

- **Key Concepts**
  Domain of a function
  Range of a function
  Continuous
  Discrete
  Modeling

II. Teaching the Lesson

In this lesson, students continue their examination of linear functions in context. Given a problem situation, students determine the domain and range of the linear functions. This lesson will build students conceptual understanding of domain and range. At this point, students have seen the graphs of lines with an all real number domain and range but students need to analyze situations where the domain and range are restricted.

- **Essential Learning and Understanding**
  It is essential for students to do the following for the attainment of this indicator:

  - Interpret linear functions that model a problem situation.
  - Find the set of x-coordinates that determines the domain of a linear function.
  - Determine the meaningful domain of a linear function for a given problem situation.
  - Some problems may require finding the zeros of the function to determine the reasonable domain.
  - Specify between discrete and continuous domains.

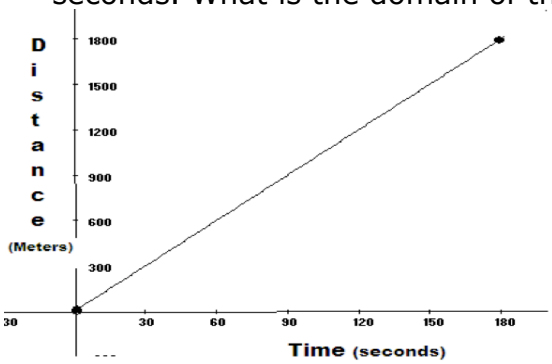
- **Examples of Essential Tasks**
  These examples of essential tasks are not all inclusive. They are provided to give additional clarification of possible tasks that students should be able to successfully complete.

  - Tony has a gross of pencils (144 pencils). He sells them for $ 0.10 each. This situation is modeled by y = 0.10x where y is the amount of money he takes in and x is the number of pencils he

sells. What is the domain of this function in the context of this situation?
Answer: Domain {0,1,2,3,4,…,144}

- Carla has a lemonade stand. She can sell <u>at most</u> 50 cups of lemonade in a day. Her daily profit is modeled by P(c) = 0.75c – 9.75. Where profit, P, is a function of cups, c. What is the reasonable domain for the function in the context of this problem?

- The graph below represents the distance traveled by a bicycle traveling at a constant speed of 10 meters/second for 180 seconds. What is the domain of the function?



- **Non-Essential Learning and Understand**
  It is not essential for students to do the following for the attainment of this indicator but could be important for the attainment of other indicators within Elementary Algebra:

  Generate the modeling function from a verbal description of the problem.

- **Examples of Non-Essential Tasks**
  The examples of non-essential tasks given below are not essential for the attainment of this particular indicator but could be important for the attainment of other indicators within Elementary Algebra.

  - Carla has a lemonade stand. She can sell at most 50 glasses of lemonade in an afternoon. Find an equation that models her daily profit and state the domain.

- **Misconceptions/Common Errors**
  Students confuse domain and range. Students confuse continuous and discrete.

- **Technology**
  Students may use technology (graph or table) to find or estimate

zeros.

III. Assessing the Lesson

Assessment Guidelines: *The objective of this indicator is to analyze given information to determine the domain and range of a linear function in a problem situation. Assessment should focus on determining the domain and range from the constraints of the problem situation.*

- **Assessment Item Examples**

  - Maria jogs each morning during the hours of 6:00 am and 10:00 am. She jogs at the rate of 3 miles per hour. This situation is modeled by the equation y = 3x where y represents the miles and x is the number of hours that Maria jogs. What is the domain of the function in this situation?
    A. $\{0 \leq x \leq 4\}$
    B. $\{6 \leq x \leq 10\}$
    C. $\{x = 3\}$
    D. $\{0 \leq x \leq 12\}$.

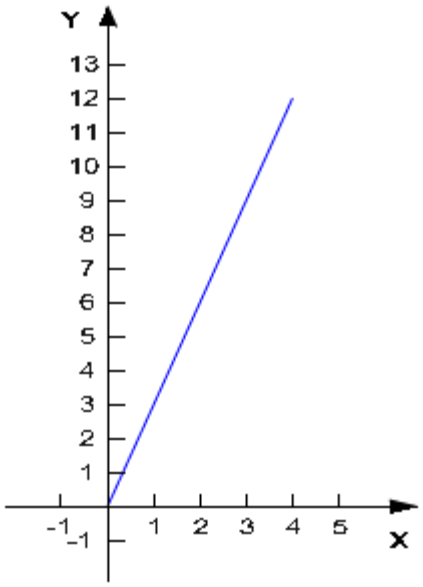
  - What is the range of this function?
    A. $\{0 \leq x \leq 4\}$
    B. $\{6 \leq x \leq 10\}$
    C. $\{x = 3\}$
    D. $\{0 \leq x \leq 12\}$.

  - The local department store received a shipment of 10 *Wiis*. The function P(w) = 250w – 500 models the profit that the store can make on this shipment. What is the domain of the function in this situation?
    A. {0, 1, 2, 3, 4,….500}
    B. {0, 1, 2, 3, 4,….250}
    C. {0, 1, 2, 3, 4,…..10}
    D. $\{0 \leq w \leq 2000\}$

  - What is the range of the function?
    A. {0, 1, 2, 3, 4,….6,250}
    B. {0, 1, 2, 3, 4,….250}
    C. {0, 1, 2, 3, 4,….10}
    D. $\{0 \leq w \leq 2000\}$

  - The temperature in a local South Carolina City rose at the rate of 3 degrees per hour the four hours during the morning of July 30th. The graph below represents the number of degrees that the

temperature rose during this four hour period. What is the domain of the function?



A. $\{0 \leq x \leq 30\}$
B. $\{0 \leq x \leq 3\}$
C. $\{0 \leq x \leq 12\}$
D. $\{0 \leq x \leq 4\}$

IV. Resources